CLAIMS

What is claimed is:

1. A device for analyzing a sample, the device comprising:

a) a body having:

i) a reaction chamber for chemically reacting the sample;

ii) a separation channel for separating components of the sample;

iii) a transition region connecting the reaction chamber to the separation channel; and

iv) at least one valve in the transition region for controlling fluid flow between the reaction chamber and the separation channel; and

b) at least two electrodes coupled to the body, the electrodes being positioned to induce the sample components to separate into bands in the separation channel when a voltage difference is applied between the electrodes;

wherein the device is in combination with and designed to be inserted into an instrument having electrical connections for applying the voltage difference between the electrodes and having at least one light source and detector for detecting the sample components in the separation channel.

2. The combination of claim 1, wherein the body further includes:

a) a side channel connected to the transition region for adding or removing fluid from the transition region; and

b) at least a second valve for controlling fluid flow through the side channel.

3. The combination of claim 2, wherein the valves comprise membrane valves, and wherein the instrument includes means for controlling the membrane valves.

4. The combination of claim 3, wherein the instrument pneumatically controls the membrane valves.

5. The combination of claim 1, wherein the instrument further includes a heater for heating the reaction chamber.

6. The combination of claim 1, wherein the instrument includes additional optics for monitoring the reaction chamber.

7. The combination of claim 1, wherein the thermal conduction of the transition region is sufficiently low so that the transition region substantially thermally isolates the reaction chamber from the separation channel.

8. The combination of claim 1, wherein the separation channel comprises an electrophoresis or IEF channel containing separation material.

9. The combination of claim 1, wherein the body has a first reservoir fluidicly connected to a first end of the separation channel and a second reservoir fluidicly connected to a second end of the separation channel, and wherein the at least two electrodes comprise:

i) a first electrode coupled to the body such that the first electrode is at least partially immersed in the first reservoir; and

ii) a second electrode coupled to the body such that the second electrode is at least partially immersed in the second reservoir.

10. The combination of claim 1, wherein each of the electrodes is embedded in the body such that one end of the electrode protrudes through an external surface of the body and such that the other end of the electrode protrudes into an internal region of the body.

11. The combination of claim 1, wherein the body comprises a polymeric material, and wherein the electrodes are over-molded in the body.

12. The combination of claim 1, wherein the electrodes are screen-printed on the body.

13. A device for analyzing a sample, the device comprising:

a) a body having:

i) a reaction chamber for chemically reacting the sample;

ii) a separation channel for separating components of the sample;

iii) a transition region connecting the reaction chamber to the separation channel;

iv) at least a first valve in the transition region for controlling fluid flow between the reaction chamber and the separation channel;

v) a side channel connected to the transition region for adding or removing fluid from the transition region; and

vi) at least a second valve for controlling fluid flow through the side channel; and

b) at least two electrodes coupled to the body, the electrodes being positioned to induce electrophoretic flow, electroosmotic flow, or isoelectric focusing of the sample components in the separation channel when a voltage difference is applied between the electrodes.

14. The device of claim 13, wherein the valves comprise membrane valves.

15. The device of claim 13, wherein the device is in combination with and designed to be inserted into an instrument having electrical connections for applying the voltage difference between the electrodes and having means for controlling the membrane valves.

16. The combination of claim 15, wherein the instrument pneumatically controls the membrane valves.

17. The device of claim 13, wherein the device is in combination with and designed to be inserted into an instrument having electrical connections for applying the voltage difference between the electrodes and having at least one light source and detector for detecting the sample components in the separation channel.

18. The combination of claim 17, wherein the instrument includes additional optics for monitoring the reaction chamber.

19. The device of claim 13, wherein the device is in combination with and designed to be inserted into an instrument having a heater for heating the reaction chamber and having electrical connections for applying the voltage difference between the electrodes.

20. The device of claim 13, wherein the side channel connects to the transition region upstream from the first valve.

21. The device of claim 13, wherein the side channel connects to the transition region downstream from the first valve.

22. The device of claim 13, wherein the thermal conduction of the transition region is sufficiently low so that the transition region substantially thermally isolates the reaction chamber from the separation channel.

23. The device of claim 13, wherein the separation channel comprises an electrophoresis or IEF channel containing separation material.

24. The device of claim 13, wherein the body has a first reservoir fluidicly connected to a first end of the separation channel and a second reservoir fluidicly connected to a second end of the separation channel, and wherein the at least two electrodes comprise:

i) a first electrode coupled to the body such that the first electrode is at least partially immersed in the first reservoir; and

ii) a second electrode coupled to the body such that the second electrode is at least partially immersed in the second reservoir.

25. The device of claim 13, wherein each of the electrodes is embedded in the body such that one end of the electrode protrudes through an external surface of the body and such that the other end of the electrode protrudes into an internal region of the body.

26. The device of claim 13, wherein the body comprises a polymeric material, and wherein the electrodes are over-molded in the body.

27. The device of claim 13, wherein the electrodes are screen-printed on the body.

28. A device for analyzing a sample, the device comprising a body having:

a) a reaction chamber for chemically reacting the sample;

b) at least a first separation region comprising a plurality of ligand-binding sites;

c) a transition region connecting the reaction chamber to the separation region; and

d) at least one valve in the transition region for controlling fluid flow between the reaction chamber and the separation region.

29. The device of claim 28, wherein the body further includes a second separation region connected to the first separation region, the second separation region comprising an isoelectric focusing channel.

30. The device of claim 28, wherein the at least one valve comprises a membrane valve, and wherein the device is in combination with and designed to be inserted

into an instrument having means for controlling the membrane valve and having at least one detector for detecting components of the sample in the separation region.

31. The device of claim 28, wherein the body further includes:

a) a side channel connected to the transition region for adding or removing fluid from the transition region; and

b) at least a second valve for controlling fluid flow through the side channel.

32. A device for analyzing a sample, the device comprising:

a) a body having:

i) a reaction chamber for chemically reacting the sample;

ii) a separation channel for separating components of the sample;

iii) a transition region connecting the reaction chamber to the separation channel; and

iv) at least one membrane valve in the transition region for controlling fluid flow between the reaction chamber and the separation channel; and

b) at least two electrodes coupled to the body, the electrodes being positioned to induce electrophoretic flow, electroosmotic flow, or isoelectric focusing of the sample components in the separation channel when a voltage difference is applied between the electrodes;

wherein the device is in combination with and designed to be inserted into an instrument having electrical connections for applying the voltage difference between the electrodes and having means for controlling the membrane valve.

33. The combination of claim 32, wherein the body further includes:

a) a side channel connected to the transition region for adding or removing fluid from the transition region; and

b) at least a second membrane valve for controlling fluid flow through the side channel.

34. The combination of claim 33, wherein the instrument includes means for pneumatically controlling the membrane valves.

35. The combination of claim 32, wherein the instrument further includes a heater for heating the reaction chamber.

36. The combination of claim 32, wherein the instrument further includes at least one light source and detector for detecting the sample components in the separation channel.

37. The combination of claim 36, wherein the instrument includes additional optics for monitoring the reaction chamber.

38. The combination of claim 32, wherein the thermal conduction of the transition region is sufficiently low so that the transition region substantially thermally isolates the reaction chamber from the separation channel.

39. The combination of claim 32, wherein the separation channel comprises an electrophoresis or IEF channel containing separation material.

40. The combination of claim 32, wherein the body has a first reservoir fluidicly connected to a first end of the separation channel and a second reservoir fluidicly connected to a second end of the separation channel, and wherein the at least two electrodes comprise:

i) a first electrode coupled to the body such that the first electrode is at least partially immersed in the first reservoir; and

ii) a second electrode coupled to the body such that the second electrode is at least partially immersed in the second reservoir.

41. The combination of claim 32, wherein each of the electrodes is embedded in the body such that one end of the electrode protrudes through an external surface of the body and such that the other end of the electrode protrudes into an internal region of the body.

42. The combination of claim 32, wherein the body comprises a polymeric material, and wherein the electrodes are over-molded in the body.

43. The combination of claim 32, wherein the electrodes are screen-printed on the body.

44. A device for analyzing a sample, the device comprising:

a) a body having:

i) a reaction chamber for chemically reacting the sample;

ii) a separation channel for separating components of the sample;

iii) a transition region connecting the reaction chamber to the separation channel; and

iv) a side channel in fluid communication with the transition region;

b) a three-way valve at the junction of the side channel and the transition region; and

c) at least two electrodes coupled to the body, the electrodes being positioned to induce electrophoretic flow, electroosmotic flow, or isoelectric focusing of the sample components in the separation channel when a voltage difference is applied between the electrodes.

45. The device of claim 44, wherein the device is in combination with and designed to be inserted into an instrument having electrical connections for applying the

voltage difference between the electrodes and having at least one light source and detector for detecting the sample components in the separation channel.

46. The combination of claim 45, wherein the instrument includes additional optics for monitoring the reaction chamber.

47. The device of claim 44, wherein the device is in combination with and designed to be inserted into an instrument having a heater for heating the reaction chamber and having electrical connections for applying the voltage difference between the electrodes.

48. The device of claim 44, wherein the thermal conduction of the transition region is sufficiently low so that the transition region substantially thermally isolates the reaction chamber from the separation channel.

49. The device of claim 44, wherein the separation channel comprises an electrophoresis or IEF channel containing separation material.

50. The device of claim 44, wherein the body has a first reservoir fluidicly connected to a first end of the separation channel and a second reservoir fluidicly connected to a second end of the separation channel, and wherein the at least two electrodes comprise:

i) a first electrode coupled to the body such that the first electrode is at least partially immersed in the first reservoir; and

ii) a second electrode coupled to the body such that the second electrode is at least partially immersed in the second reservoir.

51. The device of claim 44, wherein each of the electrodes is embedded in the body such that one end of the electrode protrudes through an external surface of the body

and such that the other end of the electrode protrudes into an internal region of the body.

52. The device of claim 44, wherein the body comprises a polymeric material, and wherein the electrodes are over-molded in the body.

53. The device of claim 44, wherein the electrodes are screen-printed on the body.

54. A device for analyzing a sample, the device comprising:

a) a body having:

i) a reaction chamber for chemically reacting the sample;

ii) a separation region for separating components of the sample;

iii) a transition region connecting the reaction chamber to the separation region; and

iv) at least one mechanical valve in the transition region for controlling fluid flow between the reaction chamber and the separation region;

b) a first electrode coupled to the body adjacent the reaction chamber;

c) a second electrode coupled to the body adjacent the transition region; and

d) a third electrode coupled to the body adjacent the separation region, the electrodes being positioned such that when a first voltage is applied between the first and second electrodes, the components in the sample are transported from the reaction chamber to the transition region, and such that when a second voltage is applied between the second and third electrodes, the sample components are transported into the separation region.

55. The device of claim 54, further comprising a molecular weight filter for filtering species in the sample having a sufficiently high molecular weight, the filter being positioned in a channel between the second electrode and the transition region such

that when the first voltage is applied between the first and second electrodes, the species are transported from the reaction chamber and collected on the filter, and such that when the second voltage is applied between the second and third electrodes, the species collected on the filter are transported into the separation region.

56. The device of claim 54, wherein the body further includes:

a) a side channel connected to the transition region for adding or removing fluid from the transition region; and

b) at least a second mechanical valve for controlling fluid flow through the side channel.

57. The device of claim 56, wherein the valves comprise membrane valves.

58. The device of claim 57, wherein the device is in combination with and designed to be inserted into an instrument having electrical connections for applying the voltages to the electrodes and having means for controlling the membrane valves.

59. The device of claim 54, wherein the device is in combination with and designed to be inserted into an instrument having electrical connections for applying the voltage difference between the electrodes and having at least one light source and detector for detecting the sample components in the separation region.

60. The combination of claim 59, wherein the instrument further includes a heater for heating the reaction chamber.

61. The combination of claim 59, wherein the instrument includes additional optics for monitoring the reaction chamber.

62. The device of claim 54, wherein the body comprises a polymeric material, and wherein the electrodes are over-molded in the body.

63. The device of claim 54, wherein the electrodes are screen-printed on the body.

64. A device for analyzing a sample, the device comprising:

a) a body having:

i) a reaction chamber for chemically reacting the sample;

ii) a separation region for separating components of the sample;

iii) a transition region connecting the reaction chamber to the separation region, wherein the thermal conduction of the transition region is sufficiently low so that the transition region substantially thermally isolates the reaction chamber from the separation region; and

iv) at least one membrane valve in the transition region for controlling fluid flow between the reaction chamber and the separation region; and

b) at least two electrodes coupled to the body, the electrodes being positioned to induce electrophoretic flow, electroosmotic flow, or isoelectric focusing of the sample components in the separation region when a voltage difference is applied between the electrodes.

65. The device of claim 64, wherein the device is in combination with and designed to be inserted into an instrument having electrical connections for applying the voltage difference between the electrodes and having means for controlling the membrane valve.

66. The combination of claim 65, wherein the instrument further includes a heater for heating the reaction chamber.

67. The combination of claim 65, wherein the instrument further includes at least one light source and detector for detecting the sample components in the separation region.

68. The combination of claim 67, wherein the instrument includes additional optics for monitoring the reaction chamber.

69. The device of claim 64, wherein the body further includes:

a) a side channel connected to the transition region for adding or removing fluid from the transition region; and

b) at least a second membrane valve for controlling fluid flow through the side channel.

70. A device for analyzing a sample, the device comprising:

a) a body having:

i) a reaction chamber for chemically reacting the sample;

ii) a separation channel for separating components of the sample;

iii) a transition region connecting the reaction chamber to the separation channel; and

iv) at least one valve in the transition region for controlling fluid flow between the reaction chamber and the separation channel; and

b) at least two electrodes coupled to the body, the electrodes being positioned to induce electrophoretic flow, electroosmotic flow, or isoelectric focusing of the sample components in the separation channel when a voltage difference is applied between the electrodes;

wherein the device is in combination with and designed to be inserted into an instrument having a heater for heating the reaction chamber and having electrical connections for applying the voltage difference between the electrodes.

71. The combination of claim 70, wherein the instrument further includes at least one light source and detector for detecting the sample components in the separation channel.

72. The combination of claim 71, wherein the instrument includes additional optics for monitoring the reaction chamber.

73. The combination of claim 70, wherein the body further includes:

a) a side channel connected to the transition region for adding or removing fluid from the transition region; and

b) at least a second valve for controlling fluid flow through the side channel.

74. The combination of claim 73, wherein the valves comprise membrane valves, and wherein the instrument includes means for controlling the membrane valves.

75. The combination of claim 70, wherein the thermal conduction of the transition region is sufficiently low so that the transition region substantially thermally isolates the reaction chamber from the separation channel.

76. The combination of claim 70, wherein the separation channel comprises an electrophoresis or IEF channel containing separation material.

77. The combination of claim 70, wherein the body comprises a polymeric material, and wherein the electrodes are over-molded in the body.

78. The combination of claim 70, wherein the electrodes are screen-printed on the body.